SECTION 16734

FIBER OPTIC RS-232 DATA MODEM

1. Description. Furnish and install Single-mode Fiber Optic RS-232 Data Modem (SMFO Modem) in locations as shown on the plan.

    A. Submittals. As a minimum, the submittal for this Item completely addresses the   following:

    - optical wavelength
    - data input/output compatibility
    - optical input/output power and range
    - transmitting device
    - optical fiber compatibility
    - power requirements
    - connectors
      optical

      data
      power
      gold plating

    - data rate
    - unit physical size
    - bit error rate

    - modulation method
    - optical detector
    - transient suppression
    - overcurrent protection
    - environmental parameters

2. Material.

    A. General Requirements. Ensure all materials furnished, assembled, fabricated or installed under this Item are new, corrosion resistant and in strict accordance with the details shown on the plans and in the specifications.

    Purchase all new modems utilized in this project from the same manufacturer. The modems provided must be fully compatible with existing field modems currently installed in traffic controller cabinets.

    B. Functional Requirements. SMFO Modem supports the transmission of full duplex data at true RS-232 levels on both the input and output circuits and operates over two (2) single mode optical fibers between specified locations as shown on the plans, as detailed in the specifications, and as directed by the Engineer.

    Optical modems will provide highly reliable, Electronic Industries Association (EIA) Compatible RS-232 data communications via a fiber optic communications link to and from multi-drop interconnected field devices and host distribution nodes. The field devices are Model 2070 traffic controllers and the host distribution node will be multi-port serial hubs installed by others.

Modem will support upstream and downstream communications via fiber optic cables in a linear multi-drop configuration. Two (2) upstream fibers (one transmit and one receive) and two (2) downstream fibers (one transmit and one receive) for a total of four fibers per each modem will be employed. Ensure modems are fully capable of operating in a linear multi-drop (i.e., "daisy chain") style configuration.

Modem will include an active repeating function (i.e. regeneration of signal), in either upstream or downstream signal direction.

Modem will be capable of receiving electrical RS-232 transmission and control signals from a local field device and converting these RS-232 electrical signals to optically modulated signals in the upstream or downstream direction.

Modem will be capable of receiving optically modulated signals from either upstream or downstream devices, converting these optical signals to RS-232 electrical transmission and control signals and providing these signals to the local field device.

Receiver inputs from an upstream modem will be repeated downstream and received inputs from a downstream modem will be repeated upstream.

Transmit and receive data rate capability of the modem will encompass all standard data rates up to 38.4 kbps (minimum). Full duplex asynchronous data transmission will be accommodated. The transmitted and received data rate will be able to change, at any time, within the above range without any mechanical adjustments (e.g. jumpers or dip switches) to the modem.

Modem will include an anti-streaming (anti-babbling) logic control over electrical to optical signal transmission with a time-out changeable by the user. The time-out range will be selectable between 4, 8, 16, 32, 64 seconds and infinity (disabled).

Fiber optic transmitting and receiving devices will operate at a nominal optical wavelength of 1310 nm and at 1550 nm.

Modems will be available as standalone units for field deployment, and as chassis mounted units for mounting in racks.

C. Electrical/Optical Requirements.

(1). Transmitting Device. Ensure the transmitting device will be capable of operating over single-mode fiber optic cable.

(2). Transmitter Optical Output. Provide an output power to 8.5/125 single mode glass fiber at a wavelength of 1310 nm to accommodate a link loss budget of 15 dB or more.

(3). Optical Detector. Provide the optical detector of the receiver to be a Pin diode.

(4). Receiver Optical Input. Ensure receiver input to have a minimum sensitivity of 15 dB below the transmitter output level and operate within the parameters of this specification.

(5). Receiver Automatic Gain Control. Receiver will have automatic gain control (AGC) circuitry to provide the receiver with the required dynamic range from transmitter-receiver spacing of 0 to 15 dB.

(6). Transmitting/Receiving Devices. Ensure the transmitting/receiving devices has a minimum mean time between failure (MTBF) of 100,000 hours at 122°F (50°C) ambient.

Ensure the devices incorporate diagnostic power and data activity input LED's in both the transmitter and the receiver for quick visual indication of link operation.

(7). Modulation. Provide FM Modulation

(8). Operating Mode. Asynchronous, full duplex.

(9). Input/Output Impedance. Per RS-232.

(10). Optical Fiber Compatibility. Optical Fiber Compatibility is 8.5/125 micron single mode glass fiber.

(11). Data Performance Requirements. Ensure digital data transmitted and received by the SMFO Modem conforms to all the requirements of EIA Standard RS-232.

(12). Data Rate. Ensure the SMFO Modem supports all required data transmission rates currently defined within an approved and published CCITT communication protocol standard. As a minimum the SMFO Modem will support data transmission rates from 9,600 bps up to and including 38,400 bits/sec.

(13). Bit Error Rate (BER). Ensure the bit error rate of each data channel does not exceed 10^{-9} power within optical budget.

(14). Power Requirements. Ensure each SMFO Modem operates at 12 to 24 volts DC from a separate power supply to be provided as part of this bid item and does not draw more than 5 Watts of power each.

Operate the separate power supply from 115 volts AC ± 10%, 60 Hz ± 3 Hz.

Rack mount units will obtain their power from the modem chassis backplane.

Ensure the equipment operation is not be affected by the transient voltages, surges and sags normally experienced on commercial power lines. Ensure responsibility to check the local power service to determine if any special design is needed for the equipment. Include extra cost, if required, in the bid of this Item.

(15). Power Service Transients. Ensure the equipment meets the requirements of Section 2.1.6, "Transients, Power Service", of the NEMA Standard TS1-1989, or the latest revision.

(16). Wiring. Ensure all wiring meets the requirements of the National Electrical Code. Cut all wires to proper length. Provide sufficient cable slack to facilitate removal and replacement of assemblies, panels, and modules. Do not double-back the wires to take up slack. Neatly lace wires into cable with nylon lacing or plastic straps. Secure cables with clamps.

(17). Transient Suppression. Provide all DC relays, solenoids, and holding coils with diodes or other protective devices across the coils for transient suppression.

(18). Power Service Protection. Ensure the equipment contains readily accessible, manually reset table or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection.

(19). Fail Safe Provision. Design the equipment such that the failures of the equipment does not cause the failure of any other unit of equipment.

D. Mechanical Requirements.

(1). Modular Design. Design modular equipment to allow major portions to be readily replaced in the field.

Mechanically key modules of unlike functions to prevent insertion into the wrong socket or connector.

Provide all modules and assemblies to be clearly identified with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.

(2). Connectors and Harnesses. Ensure all external connections are made by means of connectors. Key the connectors to preclude improper hookups. Color code and/or appropriately mark all wires to and from the connectors.

Plate each and every conductive contact surface or pin with 20 microns of gold.

Ensure optical input and output connectors have the SC type or ST type, if specified in the plans, for the single mode units.

Digital data inputs to and outputs from the SMFO Modem are via DB 9 or DB 25 RS-232 connector configured in a format compatible with the interface requirements of the data communications equipment attached.

Use a connecting harness of appropriate length and terminated with matching connectors for interconnection with the terminal equipment shown on the plans, or as directed by the Engineer.

E. Environmental Design Requirements. Ensure the equipment meets all its specified requirements during and after subjecting it to any combination of the following requirements:

(1). Stand Alone Unit

    a. Ambient temperature range of -4° F (-20° C) to 158° F (70° C).
    b. Relative humidity from 0% to 95%.

(2). Rack Mounted Modems and Chassis
    a. Ambient temperature range of +32° F (0° C) to 122° F (50° C).
    b. Relative humidity from 0% to 95%.

3. Construction Methods.

A. General. Utilize equipment design and construction of the latest available techniques with a minimum number of parts, subassemblies, circuits, cards and modules to maximize standardization and commonality.

Design the equipment for ease of maintenance. Ensure all component parts are readily accessible for inspection and maintenance. Provide test points for checking essential voltages and waveforms.

B. Mechanical Components. Ensure all external screws, nuts, and locking washers are stainless steel; no self-tapping screws are used unless approved by the Engineer.

Ensure all parts are made of corrosion resistant material, such as plastic, stainless steel, anodized aluminum or brass.

Protect all materials used in construction from fungus growth and moisture deterioration.

Separate dissimilar metals by an inert dielectric material.

C. Documentation Requirements. Provide one (1) copy of the manufacturer's operation manual at each installation location. Deliver ten additional paper copies of the manufacturer's operation manual, plus an electronic copy (in either .doc or .pdf format) to the City of Houston Project Manager prior to the first field installation.

D. Testing. Perform testing on all new modems installed in accordance with the Special Specification, "Testing, Training, Documentation, Final Acceptance and Warranty", Article 2 – 2(6). Testing includes the following:

(1). Data Performance Tests. Include all tests necessary during digital data performance testing to ensure compliance with all of the requirements of EIA Standard 232. As a minimum, these tests demonstrate data communications between the transmitting equipment and the corresponding receiving equipment of each link. These tests will, as a minimum, demonstrate data communications between the head end master modems at the designated facility and each of the corresponding remote unit(s) in the field traffic controller cabinet(s). Using a loopback plug at each master modem, a 3 minute Bit Error Rate Test (BERT) will be run from each controller cabinet field modem using a data communications test set connected to the modem's RS-232 port. The 511-bit CCITT standard pseudo-random pattern will be used for testing. For the test period (3 minutes) there will be no more then 3 bits in error (i.e. BER better then 2 x10-6). If this BER is exceeded on any channel, diagnose and correct the problem and retest at no additional cost to the City of Houston. Provide a full test report documenting all test data to the Engineer within five (5) days of the completion of the Test.

4. Measurement. Item is measured as each unit furnished, installed, made fully operational and tested in accordance with these Special Specifications or as directed by the Engineer.

5. Payment. Work performed and material furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit prices bid for each item. "Chassis for Single-mode Fiber Optic RS 232 Data Modem" specifically includes all power supplies and rack-mounting hardware necessary to mount chassis in an EIA rack. "Single-mode Fiber Optic RS-232 Data Modem (chassis mount)" includes modem only. "Single-mode Fiber Optic RS 232 Data Modem (standalone)" specifically includes a plug-in power supply. These prices

will include all equipment described under this Item with all cables and connectors, power supplies, all documentation and testing; and will include the cost of furnishing all labor, materials, training, warranty, equipment, and incidentals necessary to complete the work.

A. Single-mode Fiber Optic RS-232 Data Modem (standalone)   Per Unit

B. Single-mode Fiber Optic RS-232 Data Modem (chassis mount)   Per Unit

C. Chassis for Single-mode Fiber Optic RS-232 Data Modem   Per Unit

END OF SECTION